Thesis for M.D. Degree.

The Distribution of Phthisis in England

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The distribution of Phthisis in England

Phthisis which is in this country the most commonly fatal of all diseases, is at the same time one of the large class of preventable diseases. During the past fifty years — the period during which there has been efficient Registration of disease — Phthisis mortality has always exceeded the mortality from any other disease ~~by~~ The total deaths from Phthisis exceeding those from the next most frequent cause of death Bronchitis — by from five to fifteen thousand yearly — There are few diseases for which legislation & improvements in general & individual hygiene has done more to lessen

than Phthisis as will be seen by a study of the statistics of the disease On this subject the late Dr Parkes says

"The attention now paid to Public Health is in a large degree owing to a careful collection of statistics of Births Deaths & the Causes of death which has been collected in England during the last 38 years – It may truly be said that not only all Europe but gradually the entire world has been influenced by the work of the Registrar General for England – We are now able to determine the limits of mortality & its causes, with some precision & are being led up to the consideration of the causes which bring about a too high death-rate."

There is no other single disease the economic loss by which to the State is so great as that by Phthisis. for the majority of its victims have just attained to early manhood or womanhood

the period of greatest value in the lifetime of the individual to the State. - Hence the necessity of State aid in carrying out measures for its prevention.

The present investigation was undertaken while working at the Museum of Hygiene Margaret Street London with the object of ascertaining the causes governing the distribution of Phthisis & those which have had the effect of lessening its fatality. The influence of health on the Human Race is so powerful for good or evil that such an investigation as the present into the statistics of deaths from any one cause ~~of disease~~ acquires its greatest importance in the fact that such must be accepted as our only gauge of the health of a community & when the statistics are analysed they form one of the best means of arriving at the true etiology of the disease.

How far death rates are valuable as indicating the prevalence of one disease or another depends greatly on the nature of the disease & the accuracy of the diagnosis. — Death rates of such diseases as Scarlet-Fever - Measles - Diphtheria &c indicate rather the degree of severity of the disease than the degree of prevalence — but with Phthisis this is different, for though not absolutely accurate as indicating its prevalence in certain districts for there are errors of diagnosis to be allowed for & migration of Phthisical patients, yet Phthisis death rates are sufficiently accurate & constant to enable us to draw conclusions as to the etiology of the disease & the means of its prevention.

The difficulties to be contended with in undertaking a statistical investigation such as the present so as to eliminate as far as possible

all sources of error are only known to those who have had experience in dealing with statistics, for none of the factors are constants. There is no more inconstant factor than the population of a district. Age - Sex - Occupation - & habits of the people as also the Climate & surroundings in which they live influence the comparibility of the populations of different districts However in the following tables of figures (page 15) no ~~such~~ corrections have been made for the above otherwise the results could not have been compared in such a variety of Ways & the etiological value of the statistics must necessarily have been interfered with. It is therefore necessary to keep this in mind while studying the figures.

There is one class of corrections which might perhaps with profit be applied to such an investigation & that is

corrections for the mathematical errors which arise when dealing with masses of figures — Both Dr Radicke & Dr Ramsey lay stress on the necessity of correcting for this, but fortunately the figures on which this investigation is based are so large that the errors of the means need hardly be considered except in the case of a few of the smaller districts such as Rutland - Bedford & Monmouth & there are districts upon which no stress will be put as they show nothing characteristic from which conclusions can be drawn. (1) (24) (26) As regards the small Welsh counties I have followed the plan adopted by the Registrar General for England & grouped them into the two divisions of North & South Wales. North Wales includes — Anglesey Caernarvon, Denbigh, Merionith Montgomery & Flint. & South

Wales including — Cardigan Pembroke Caermarthen Radnor Brecknock & Glamorgan.
Whenever feasable I have indicated results on charts & Maps as being a more impressionable method of demonstrating facts than by constantly referring to lengthy tables of figures. however in nearly every instance I have appended the figures which are used in the construction of the Charts.

In 1875 Dr. Haviland published a costly work on the Geographical distribution of Phthisis in England during the decennial 1851-1860 — but since then so much change has occured in the distribution of population — in hygiene both general & individual & in the pathological views of the disease that Dr. Havilands (15)

conclusions can no longer be looked on as applicable to at the present time.

I have chosen the ten years 1871 - 1880 as being the most recent period which can be dealt with definitely - For, the census returns of 1871 & 1881 enable us to calculate with precision the actual populations during the intervening years. So that the results in the following tables will differ from those calculated by the Registrar general who had who had to estimate the population from the rate of increase during the previous ten years.

The Registration counties have been used for convenience for though each is made up of a varying number of Union districts of different sizes - the populations of which live under the most varied conditions yet these small registration 'Unions' if used would involve additional

sources of error — The origin of these Union districts is a matter for the archeologist — Suffice it here to say that no uniform rule guided their construction — & that the grouping of these into Registration districts or Counties is also irregular. — The Registration County does not correspond with that marked in the Ordnance Survey Maps, as the smaller Union districts often extend into two Ordnance Counties — This must be borne in mind in examining the density of Population &c. for the two cannot be compared without Error. In such an inquiry as the present one cannot proceed without first considering the validity of the most important datum on which it is based namely the number of deaths from Phthisis — Unfortunately there is probably no disease in medicine

about the nature of which there are more widely diverse views than Phthisis - Some practioners holding it to be a tuberculosis & therefore referring their now tubercular cases to other causes whilst with many it is a convenient term for a host of diseases - In his report for 1881 the Registrar General has shown that during the previous thirty years, Phthisis Rates have been decreasing while Rates from other pulmonary diseases have had a corresponding increase - This he maintains is due to a wider diffusion of more accurate clinical methods & therefore more accurate diagnosis - The disease which is apparently most frequently confounded with Phthisis is Bronchitis & the increase in the Bronchitis rates which has taken place lately corresponds very closely to the decrease in Phthisis

rates The Registrar General has therefore to include under the term Phthisis both tubercular & non-tubercular cases – & till more ready method of diagnosis become generale the two forms must remain united. However Non tubercular or fibroid disease may for convenience be grouped among the varieties of Phthisis both because there is usually symptoms of decline & a tendency to degeneration & caseation & later liability to tubercle in other parts of the lung as a secondary change and also because in some forms of tubercular disease there is a large amount of fibroid change in the more healthy parts of the lung – so that the two forms are intimately connected pathologically The clinical relations of the two forms are even more intimate & no hard & fast rule can be given as to which are tubercular

& which are not. The relative frequency of the two forms has not yet been determined satisfactorily Probably purely non-tubercular cases at death are much less frequent than generally supposed & this is a point of great etiological & prognostic value - For the majority of cases begin by some non tubercular affection of the lung - enfeebling the body & rendering the lung more susceptible to tuberculosis - It is of the greatest importance therefore to bear this in mind when examining the tables of distribution - for, localities & occupations exposing patients to these primary lesions are the places which put their population in the best possible position to render them susceptible to the fatal microorganism when present

In the following tables the populations of each of the 47 districts has been calculated from the Census returns of 1871 & 1881 –

The number of deaths from all causes & the number from Phthisis is taken from the Annual Reports of the Registrar General.

From these data General Rates & Rates ~~from~~ for Phthisis have been calculated per thousand of the population living during each of ten years & for each of the districts

London (Middlesex)

Population	Total Deaths	Deaths fr Phthisis	Rate fr all causes	Rate from Phthisis
71 2.286568	57034	6277	24.94	2.74
72	50619	6131	21.82	2.65
73	53104	6126	22.70	2.61
74	54642	6081	23.09	2.57
75	56656	6389	23.68	2.65
76	53976	6488	22.31	2.67
77	53993	6239	22.08	2.53
78	57142	6578	23.12	2.66
79	57443	6407	22.99	2.56
80	55322	5931	21.91	2.34
81 2,350,586				
Mean Rates for decenniad			22.87	2.60

London (Surrey)

71 742155	18893	1901	25.43	2.56
72	16417	1937	21.42	2.52
73	17794	2002	22.50	2.53
74	17584	1927	21.61	2.36
75	20297	2194	24.23	2.61
76	18596	2153	21.58	2.49
77	18860	2090	21.30	2.36
78	21041	2227	23.14	2.45
79	20986	2179	22.49	2.33
80	20896	1999	21.84	2.08
81 980522				
Mean Rates for decenniad			22.55	2.42

16.

London (Kent)

187	Total Deaths	Deaths from Ph:	Rate from all causes	Rate from Ph.
1871	4503	508	19.96	2.25
1872	4319	521	18.61	2.25
1873	4561	553	19.20	2.33
1874	4587	513	18.88	2.10
1875	5011	581	20.00	2.32
1876	5105	587	19.98	2.29
1877	4596	537	17.57	2.05
1878	6005	616	22.07	2.30
1879	5376	578	19.66	2.11
1880	5614	544	20.09	2.94
Mean —	4967.7	554.0	19.6	2.19

Surrey (Exmetropolitan)

1871	6558	757	17.9	2.07
1872	6218	804	16.5	2.14
1873	6182	794	16.6	2.06
1874	6611	743	16.7	1.82
1875	7392	802	18.3	1.96
1876	7032	819	17.0	1.98
1877	6639	791	15.6	1.86
1878	7429	850	17.1	1.96
1879	7677	795	17.3	1.79
1880	7550	730	16.6	1.61
Mean'	6928	788	16.9	1.92

Kent (exclusive of Metropolitan)

	Total Deaths	Deaths from Ph:	Rate per all causes	Rate from Ph:
1871	11882	1261	18·88	2·00
1872	11482	1237	18·02	1·94
1873	11041	1225	17·11	1·89
1874	11581	1143	17·73	1·75
1875	12780	1267	19·33	1·91
1876	11701	1209	17·19	1·80
1877	11728	1184	17·32	1·75
1878	12320	1293	17·99	1·88
1879	12129	1225	17·49	1·76
1880	12447	1183	17·76	1·68
Mean	11909	1222	17·88	1·83

Sussex.

1871	7778	1030	18·47	2·44
1872	7252	937	16·90	2·14
1873	7238	903	16·61	2·07
1874	7768	968	17·53	2·16
1875	8285	969	18·17	2·15
1876	7600	907	16·50	1·98
1877	7358	942	15·80	2·26
1878	8459	957	17·90	2·02
1879	8006	890	16·81	1·85
1880	8277	886	17·00	1·79
Mean.	7802	938	17·14	2·08

Hampshire

	Total Deaths	Deaths from Ph:	Rate fr all causes	Rate fr. Phthisis
1871	10221	1250	19.42	2.37
1872	9601	1187	18.05	2.23
1873	9177	1185	17.12	2.21
1874	9843	1128	18.19	2.08
1875	10447	1271	19.13	2.34
1876	10598	1180	19.05	2.14
1877	9603	1247	17.28	2.24
1878	10610	1286	18.90	2.29
1879	9893	1207	17.49	2.13
1880	10674	1181	18.70	2.07
Mean —	10067	1212	18.33	2.21

Berkshire

1871	4383	494	19.37	2.18
1872	3893	458	17.04	1.99
1873	3879	471	16.82	2.04
1874	4136	462	17.77	1.98
1875	4693	496	20.02	2.08
1876	4160	442	17.55	1.86
1877	4106	454	17.12	1.89
1878	4529	434	18.76	1.79
1879	4542	460	18.65	1.88
1880	4464	402	18.17	1.63
Mean.	4268	457	18.12	1.93

Middlesex (ex metropolitan)

	Total Deaths	Deaths fr: Phthisis:	Rate all causes	Rate fr: Phthisis.
1871	5474	567	20.66	2.10
1872	5081	564	18.38	2.04
1873	5445	575	18.94	1.99
1874	5367	533	17.92	1.84
1875	6011	590	19.31	1.89
1876	5925	610	18.36	1.89
1877	5538	570	16.66	1.70
1878	6406	609	18.81	1.76
1879	6393	567	17.88	1.59
1880	6332	543	17.97	1.47
Mean	5797	574	18.44	1.82

Hertford

1871	3974	387	20.42	1.99
1872	3661	359	18.73	1.83
1873	3500	346	18.78	1.76
1874	3551	372	18.03	1.88
1875	4122	403	18.84	2.03
1876	3469	360	18.47	1.81
1877	3229	310	16.20	1.55
1878	3696	366	18.48	1.82
1879	3698	298	18.42	1.48
1880	3567	315	17.70	1.56
Mean	3646	351	18.40	1.77

Buckingham

	Total Deaths	Deaths from Phthisis	Rate p. All Causes	Rate p. Phthisis
1870				
1871	3183	279	20.53	1.79
1872	2872	293	18.67	1.89
1873	2700	264	17.39	1.70
1874	2815	245	18.12	1.58
1875	3129	278	20.14	1.79
1876	2840	256	18.26	1.64
1877	2668	284	17.15	1.82
1878	2900	232	18.63	1.49
1879	3034	255	19.47	1.63
1880	2801	239	17.97	1.52
Mean	2894	262	18.61	1.68

Oxford

1871	3701	366	20.75	2.05
1872	3259	356	18.22	1.98
1873	3483	360	19.45	2.01
1874	3336	342	18.60	1.90
1875	3697	319	20.58	1.72
1876	3249	362	18.08	2.01
1877	3292	307	18.25	1.64
1878	3508	329	19.42	1.82
1879	3323	315	18.31	1.74
1880	3266	314	17.01	1.73
Mean	3409	336	18.86	1.86

Northampton

	Total Deaths	Deaths from Ph:	Rate from all causes	Rate from Phthisis
1871	5021	536	20.22	2.23
1872	5245	532	20.88	2.11
1873	4760	480	18.74	1.88
1874	5057	446	19.68	1.73
1875	5322	516	21.25	1.98
1876	4903	471	18.59	1.79
1877	5009	471	18.86	1.77
1878	5385	501	20.06	1.86
1879	5169	493	18.05	1.81
1880	5398	410	19.67	1.50
Mean	5146	487	19.60	1.86

Huntingdon

1871	1162	122	20.01	2.11
1872	1022	128	17.20	2.22
1873	980	115	17.16	2.01
1874	1039	105	18.18	1.85
1875	1233	118	21.97	2.10
1876	960	111	17.25	1.99
1877	907	113	16.44	2.04
1878	915	84	16.07	1.53
1879	1024	91	18.89	1.68
1880	1032	80	19.21	1.64
Mean	1027	97	1823	1.91

Bedford

	Total Deaths	Phthisis deaths	Rate p. all causes	Rate fr. Phthisis
1871	3080	389	20.32	2.56
1872	2870	324	18.90	2.14
1873	2622	321	17.28	2.11
1874	3002	327	19.70	2.14
1875	3197	311	20.94	2.03
1876	3007	342	19.66	2.23
1877	2664	288	17.36	1.88
1878	3113	307	20.28	2.00
1879	2998	328	19.50	2.16
1880	3064	302	19.96	1.96
Mean	2961	323	19.38	2.11

Cambridge

1871	3733	431	19.43	2.23
1872	3645	422	18.98	2.19
1873	3336	371	17.38	1.93
1874	3466	337	18.07	1.75
1875	4169	425	21.75	2.21
1876	3317	378	17.31	1.97
1877	3396	373	17.73	1.94
1878	3646	355	19.04	1.85
1879	3647	363	19.06	1.89
1880	3587	348	18.75	1.82
Mean	3594	380	18.74	1.97

Essex

	Total Deaths	Phthisis deaths	Rate all causes	Rate (Phthisis)
1871	8727	941	19·79	2·34
1872	8007	912	17·71	2·01
1873	8393	910	18·12	1·96
1874	8484	845	17·88	1·78
1875	9209	922	18·96	1·89
1876	8573	911	17·26	1·83
1877	8715	926	17·16	1·82
1878	9417	928	18·14	1·78
1879	9399	914	17·84	1·72
1880	10165	891	18·78	1·64
Mean	8908	910	18·13	1·87

Suffolk

1871	6992	788	20·13	2·27
1872	6384	754	18·35	2·16
1873	6144	712	17·63	2·04
1874	6325	649	18·11	1·85
1875	7026	735	20·08	2·11
1876	6172	683	17·61	1·94
1877	6547	731	18·65	2·08
1878	6731	718	1814	2·04
1879	6968	702	1978	1·99
1880	6545	677	1883	1·91
Mean	6583	714	1973	2·03

Norfolk

	Total Deaths	Phthisis deaths	Rate all Causes	Rate fr Phthisis
1871	9040	895	20.99	2.05
1872	8496	935	19.69	2.16
1873	8444	868	19.54	2.00
1874	8470	774	19.57	1.78
1875	9297	887	21.44	2.04
1876	8049	842	18.53	1.93
1877	8042	810	18.49	1.86
1878	8752	864	20.09	1.96
1879	8492	800	19.46	1.83
1880	8873	738	20.30	1.68
Mean	8595	841	19.81	1.92

Wiltshire

1871	4687	468	20.86	1.92
1872	4283	484	17.47	1.97
1873	4197	419	17.09	1.70
1874	4763	425	19.36	1.72
1875	5030	450	24.19	1.82
1876	4413	393	17.88	1.58
1877	4449	443	17.99	1.79
1878	4739	409	19.10	1.65
1879	4810	403	19.39	1.62
1880	4407	390	17.73	1.56
Mean	4777	428	19.10	1.73

Dorsetshire.

	Total Deaths	Deaths fr: Phthisis	Rate fr: All causes	Rate fr: Phthisis
1871	3493	348	18·48	1·83
1872	3128	328	16·64	1·74
1873	3011	326	15·99	1·75
1874	3254	292	17·42	1·55
1875	3751	358	20·01	1·91
1876	3160	279	16·36	1·49
1877	3079	343	16·52	1·83
1878	3160	313	16·97	1·68
1879	3487	327	18·76	1·76
1880	3122	301	1683	1·62
Mean	3264	321	17·39	1·71

Devonshire

1871	12677	1354	20·91	2·23
1872	11648	1368	19·21	2·23
1873	11249	1206	18·54	1·98
1874	11483	1217	18·92	2·00
1875	12456	1280	20·51	2·10
1876	11797	1195	19·38	1·93
1877	11405	1214	18·77	1·99
1878	12677	1316	20·86	2·16
1879	11914	1300	19·58	2·13
1880	12167	1097	20·00	1·80
Mean	11947	1254	19·66	2·05

Cornwall

	Total Deaths	Phthisis Deaths	Rate pr: all Causes	Rate pr: Phthisis
1871	7182	856	20.04	2.39
1872	7146	838	20.01	2.35
1873	6685	775	18.42	2.20
1874	7039	764	20.18	2.19
1875	7288	720	21.09	2.08
1876	7180	792	20.97	2.31
1877	6878	755	20.28	2.22
1878	6801	671	20.23	1.99
1879	6343	681	19.06	2.04
1880	7021	672	21.30	2.03
Mean	6954	753	20.15	2.18

Somersetshire

1871	9482	850	19.66	1.76
1872	8962	884	18.53	1.82
1873	8977	774	18.52	1.60
1874	9238	805	19.02	1.63
1875	10246	852	21.08	1.75
1876	9115	760	18.73	1.56
1877	8893	824	18.24	1.69
1878	9482	806	18.42	1.64
1879	9581	766	19.59	1.57
1880	8935	719	18.24	1.47
Mean	9291	804	19.00	1.64

Gloucestershire

	Total Deaths	Phthisis deaths	Rate fr: all causes	Rate fr: Phthisis
1871	9900	1027	20.26	2.10
1872	9188	933	18.66	1.89
1873	9648	924	19.44	1.86
1874	9986	865	19.98	1.73
1875	11282	1018	22.41	2.03
1876	10254	894	20.23	1.76
1877	9811	870	19.21	1.70
1878	10251	937	19.93	1.82
1879	10202	910	19.70	1.75
1880	9938	811	19.06	1.55
Mean	10046	918	19.88	1.81

Hereford

1871	2169	195	17.96	1.61
1872	1969	178	16.33	1.47
1873	2038	192	16.96	1.59
1874	2253	179	18.78	1.49
1875	2352	201	19.64	1.67
1876	2296	177	19.22	1.48
1877	2098	175	17.66	1.46
1878	2083	157	17.51	1.32
1879	2359	190	21.56	1.60
1880	2084	170	17.59	1.43
Mean	2190	182	18.31	1.51

Shropshire

	Total Deaths	Phthisis Deaths	Rate p: All Causes	Rate p Phthisis
1871	5092	510	19.07	1.90
1872	4990	472	18.68	1.76
1873	4892	445	18.33	1.66
1874	4969	420	18.63	1.57
1875	5312	429	19.92	1.60
1876	5142	437	19.29	1.64
1877	4858	425	18.24	1.60
1878	5103	463	19.16	1.73
1879	5119	395	19.23	1.48
1880	4619	375	17.36	1.40
Mean	5009	437	18.79	1.63

Staffordshire

1871	20832	1572	23.74	1.79
1872	22012	1531	24.72	1.72
1873	20436	1575	22.62	1.74
1874	21184	1446	23.12	1.57
1875	21720	1563	23.37	1.57
1876	20739	1544	22.00	1.63
1877	20771	1506	21.77	1.57
1878	22475	1537	23.21	1.58
1879	20585	1423	20.98	1.45
1880	20686	1374	20.81	1.48
Mean	21144	1507	22.63	1.61

Worcestershire

	Total Deaths	Phthisis Deaths	Rate pr: all causes	Rate pr: Phthisis
1871	6570	576	19·53	1·71
1872	6519	534	19·13	1·56
1873	6252	535	18·00	1·54
1874	6727	519	19·23	1·48
1875	7340	563	20·67	1·58
1876	6635	513	18·44	1·43
1877	6649	532	18·25	1·46
1878	7690	535	20·84	1·45
1879	7261	507	20·43	1·35
1880	6494	510	17·16	1·34
Mean	6813	532	19·06	1·49

Warwickshire

1871	14455	1359	22·92	2·15
1872	13586	1364	21·21	2·11
1873	14648	1354	22·50	2·08
1874	16034	1325	24·27	2·00
1875	15975	1376	23·84	2·05
1876	14193	1273	20·85	1·87
1877	14797	1327	21·43	1·92
1878	15868	1390	22·65	1·98
1879	15008	1283	21·12	1·80
1880	14481	1246	20·09	1·72
Mean	14904	1329	22·08	1·96

Leicestershire

	Total Deaths	Phthisis Deaths	Rate all causes	Rate fr: Phthisis
1871	6034	535	21·96	1·94
1872	6544	577	23·34	2·05
1873	6025	541	21·10	1·89
1874	6283	511	21·61	1·75
1875	7159	513	24·20	1·73
1876	6493	520	21·57	1·72
1877	6351	530	20·75	1·73
1878	6466	580	20·77	1·86
1879	6845	527	21·63	1·66
1880	6814	490	21·19	1·53
Mean	6499	532	21·81	1·78

Rutland

1871	465	42	19·80	1·79
1872	408	34	17·04	1·45
1873	417	31	17·88	1·32
1874	360	20	15·47	0·86
1875	431	27	18·55	1·11
1876	435	29	18·75	1·25
1877	449	30	19·39	1·29
1878	462	48	19·94	2·07
1879	415	35	17·74	1·51
1880	439	33	19·06	1·43
Mean	428	32	18·36	1·40

Lincolnshire

	Total Deaths	Phthisis Deaths	Rate all Causes	Phthisis Rate
1871	8222	824	19.20	1.92
1872	7962	781	18.44	1.80
1873	7895	786	18.10	1.80
1874	8319	758	18.97	1.73
1875	8845	750	20.00	1.69
1876	7984	769	17.91	1.72
1877	7966	732	17.74	1.62
1878	8525	707	18.83	1.56
1879	8367	694	18.34	1.52
1880	8590	721	18.69	1.56
Mean	8267	752	18.62	1.69

Nottinghamshire

1871	7683	807	21.05	2.27
1872	8209	775	22.54	2.13
1873	7594	766	20.41	2.06
1874	8505	774	22.68	2.34
1875	9242	810	23.77	2.08
1876	8468	819	21.32	2.06
1877	8062	718	19.88	1.77
1878	8306	772	20.07	1.86
1879	8809	798	20.87	1.89
1880	9401	746	21.84	1.73
Mean	8427	778	21.41	2.01

~~Derbyshire~~ Cheshire

	Total Deaths	Phthisis Deaths	General Rate	Phthisis Rate
1871	11915	1202	22.07	2.22
1872	11436	1282	20.86	2.33
1873	11348	1174	20.39	2.11
1874	12512	1123	22.16	1.98
1875	13108	1174	22.88	2.04
1876	12603	1136	21.69	1.95
1877	11686	1116	19.84	1.89
1878	12671	1172	21.20	1.96
1879	12589	1197	20.77	1.97
1880	12303	1087	20.03	1.76
Mean	12217	1166	21.18	2.02

Derbyshire

1871	6763	~~1202~~ 698	20.81	2.14
1872	6786	~~1282~~ 709	20.49	2.14
1873	7101	~~1174~~ 678	21.05	2.01
1874	7385	~~1123~~ 633	21.50	1.84
1875	7718	~~1174~~ 617	22.08	1.76
1876	7508	~~1136~~ 666	21.10	1.87
1877	6998	~~1116~~ 674	19.33	1.86
1878	7509	~~1172~~ 732	20.40	1.98
1879	8033	~~1197~~ 717	21.47	1.91
1880	7250	~~1085~~ 645	19.06	1.69
Mean	7306	~~1166~~ 676	20.72	1.92

Lancashire

	Total Deaths	Phthisis Deaths	General Rate	Phthisis Rate
1871	78,752	8212	27.63	2.88
1872	73,549	8156	25.24	2.78
1873	74,851	7748	25.15	2.60
1874	84,444	7528	27.77	2.47
1875	81324	8122	26.20	2.61
1876	80165	7795	25.30	2.46
1877	77343	7790	23.93	2.41
1878	82440	7956	25.62	2.40
1879	80482	7616	23.96	2.26
1880	81812	7229	23.90	2.10
Mean	79716	7815	25.27	2.49

Yorkshire West-Riding

1871	44863	4704	24.19	2.53
1872	46602	4699	24.67	2.47
1873	45140	4544	23.47	2.36
1874	49616	4219	25.55	2.15
1875	49775	4696	25.04	2.35
1876	47393	4785	23.29	2.34
1877	44759	4672	21.72	2.21
1878	49160	4709	23.46	2.24
1879	46757	4642	21.95	2.17
1880	46794	4228	21.62	1.95
Mean	47115	4576	23.49	2.27

Yorkshire East Riding

	Total Deaths	Phthisis Deaths	General Rates	Phthisis Rates
1871	6432	628	20.98	2.04
1872	7200	676	23.05	2.16
1873	6711	626	21.10	1.96
1874	7109	673	21.96	2.07
1875	7938	699	24.10	2.12
1876	6746	628	20.13	1.87
1877	6817	658	20.01	1.90
1878	7486	721	21.61	2.08
1879	7356	680	20.89	1.93
1880	6656	597	18.60	1.64
Mean	7045	657	21.24	1.97

Yorkshire North Riding

1871	4811	480	20.46	2.04
1872	4865	397	19.87	1.62
1873	4721	415	18.53	1.62
1874	4942	405	18.67	1.53
1875	5871	498	21.37	1.81
1876	5936	530	20.85	1.85
1877	5865	546	19.91	1.85
1878	6272	500	20.59	1.64
1879	5904	508	18.77	1.61
1880	6624	521	20.41	1.65
Mean	5581	480	19.94	1.72

Durham

	Total Deaths	Phthisis Deaths	General Rate	Phthisis Rate
1871	21124	1476	28.46	1.98
1872	19625	1662	25.97	2.19
1873	19200	1548	24.97	2.01
1874	21701	1549	27.78	1.98
1875	20282	1514	25.49	1.90
1876	16926	1541	20.92	1.90
1877	17619	1630	21.39	1.98
1878	19204	1544	22.98	1.84
1879	16996	1556	20.02	1.83
1880	19796	1567	22.85	1.81
Mean	19247	1558	24.08	1.94

Northumberland

1871	9842	963	25.45	2.49
1872	8936	877	23.83	2.24
1873	9705	913	24.49	2.36
1874	10338	934	25.78	2.32
1875	9795	910	24.14	2.24
1876	8797	948	21.43	2.31
1877	8622	990	20.77	2.38
1878	9130	992	21.74	2.12
1879	9118	910	21.47	2.14
1880	9032	897	21.03	2.08
Mean	9331	933	22.91	2.26

Cumberland

	Total Deaths	Phthisis Deaths	General Rate	Phthisis Rate
1871	4928	571	22.37	2.59
1872	5142	570	23.02	2.55
1873	5283	572	23.26	2.52
1874	5465	514	23.81	2.24
1875	5401	473	23.23	2.03
1876	4866	506	20.62	2.14
1877	4653	517	19.51	2.16
1878	4706	453	19.48	1.87
1879	5009	532	20.48	2.17
1880	5153	466	20.80	1.88
Mean	5059	517	21.65	2.21

Westmorland

1871	1215	164	18.65	2.51
1872	1124	146	17.27	2.24
1873	1091	130	16.70	2.00
1874	1212	111	18.60	1.86
1875	1192	123	18.36	1.89
1876	1104	115	17.11	1.77
1877	1067	123	16.50	1.90
1878	1144	120	17.71	1.85
1879	1142	142	17.55	2.20
1880	1177	140	18.27	2.17
Mean	1146	131	17.67	2.03

Monmouth

	Total Deaths	Phthisis Deaths	General Rate	Phthisis Rate
1871	5180	442	23.67	2.01
1872	4712	426	21.30	1.92
1873	4803	416	21.67	1.86
1874	5517	429	24.70	1.91
1875	5047	391	22.37	1.73
1876	4592	392	20.22	1.72
1877	4507	391	19.72	1.71
1878	4948	418	21.58	1.81
1879	4950	419	21.39	1.81
1880	4520	340	19.41	1.45
Mean.	4877	406	21.58	1.79.

South Wales

1871	16.113	2112	21.01	2.71
1872	16709	2003	21.46	2.57
1873	16634	2171	21.06	2.74
1874	19470	1942	24.30	2.42
1875	18342	2114	22.42	2.60
1876	16416	2092	19.92	2.41
1877	17000	2074	23.45	2.48
1878	17876	2243	21.60	2.64
1879	16943	2123	19.86	2.48
1880	18281	2087	21.02	2.28
Mean	17378	2096	21.60	2.53

North Wales

	Total Deaths	Phthisis Deaths	General Rates	Phthisis Rates
1871	8659	1250	19·90	2·82
1872	8682	1128	19·83	2·57
1873	9185	1237	20·62	2·80
1874	8860	1039	19·99	2·34
1875	10059	1227	22·53	2·75
1876	9743	1205	20·63	2·68
1877	9254	1187	20·60	2·62
1878	9235	1121	20·34	2·46
1879	9481	1127	20·75	2·46
1880	9257	1083	20·14	2·35
Mean	9241	1160	20·62	2·58.

From the foregoing tables I have constructed chart- No 1 which shows the mean Phthisis rate for each district- for each year during the decennium. Column No 12 of this chart- giving the mean rate for the ten years for each district- & at the foot- of the chart- the means are given for each year. In chart- No 2 I have attempted to give a general idea by shading of the distribution of Phthisis — the darkest- colour representing the greatest Phthisis mortality-. By this means is shown very clearly the great preponderance of Phthisis in the Western counties- Cornwall. Devon, North & South Wales, Cheshire, Lancashire, - West-riding of Yorkshire, Cumberland & Westmorland. A similar fact- is demonstrated in Dr. Havilands map of the Distribution of Phthisis among females No 3 Taking the groups of Counties.

according as they are on the East-South & West coasts & the midland ones, the following table gives their relative Phthisis rates.

Eastern Districts

- Kent-
- Essex
- Lincoln
- Suffolk
- Norfolk
- East-Yorkshire
- North York.
- Durham
- Northumberland

Phthisis Rate 1.91
General Rate 20.26

Southern Districts

- Dorset-
- Hampshire
- Sussex

Phthisis rate 2.0
General Rate 17.62

Western Districts

- Cumberland
- Westmorland
- Lancashire
- West Yorkshire
- Cheshire
- North Wales
- South Wales
- Somerset-
- Devon
- Cornwall

Phthisis Rate 2.2
General Rate 22.01

IV Midland Districts

- Derby
- Nottingham
- Shropshire
- Staffordshire
- Leicester
- Rutland
- Northampton
- Warwick
- Worcester
- Hereford — Phthisis Rate 1.79
- Gloucester — General Rate 19.46
- Monmouth
- Oxford
- Huntingdon
- Bedford
- Cambridge
- Hertford
- Buckshire
- Berkshire
- Surrey
- Wiltshire

I	Western Districts	Phthisis	2.2	General	22.0
II	Southern Districts	"	2.0	"	17.6
III	Eastern	"	1.9	"	20.2
IV	Midland	"	1.7	"	19.4.

How far exposure to East or West influences the distribution of the disease will be considered later. The tables however demonstrate the fact of its being by far most prevalent on the West Coast next most prevalent on the South or more correctly South West for our South Coast is chiefly influenced by the West Winds - thirdly on the East. & least in the Midland districts.

One would naturally look for a corresponding sequence in the General Rates but this is not the case - Neither Density of the population nor occupation have the same influence on Phthisis as on General Rates as is shown in Chart-4

The irregular distribution of Phthisis will most profitably be considered in relation to the Causes which are said to influence the disease - in the

following order. —

- I Atmospheric Conditions
  - Composition — CO_2 - Ozone
  - Temperature
  - Moisture
  - Impurities
    - Inorganic
    - Organic
    - Micro-organisms
  - Movement
- II Conditions in the Soil
  - Structure
  - Inclination
  - Exposure
  - Water
    - Surface
    - Subsoil
  - Heat
  - Germs
- III Conditions in the individual
  - Heredity
  - Race
  - Contagion
  - Habits of Life
  - Occupation
  - Hygiene
    - Individual
    - General

Composition of the Air. That pure air varies considerably in the relative amounts of its components is a well known fact — The dense, moist-, cool, well oxygenated & ozonized air from the sea may be contrasted with the less dense dry inland air. Both have been put- forward as specifics against- certain diseases especially Phthisis for both types of pure air have their advocates in this disease. This is an extremely important- & interesting fact- to those who hold that- Phthisis (tubercular) is contagious - a theory which is gaining ground daily - for the two types of air agree only in the absence of impurities — It also goes to prove certain anomalies in the distribution of the disease. - (39)
Dr. Yeo in his work on Climate says (40)
that the high districts of Switzerland & the Tyrol are free or nearly free from tubercular disease yet- Pneumonia

Pleurisy & Bronchitis — the common forerunners of tubercular disease are markedly frequent. How the air in these districts has been shown & otherwise by bacteriological research to be relatively pure. It is probably to its purity that the immunity from Phthisis of the Natives is due.

As to the influence of the constituents of air on the body — by far the most important is oxygen & its allotropic modification Ozone. Its action is twofold — I supplying the necessary oxygen to sustain life & II acting as an oxidising agent on impurities rendering them innocuous — In open spaces, oxygen is equally distributed over the Globe, or nearly so, as is shown by Dr Smith's Analyses, but this is not the case in enclosed spaces where it exists in an inverse proportion to the number of occupants of the space. This

(35)

is important - for by far the larger number of patients who enter Brompton Hospital are engaged in "indoor" occupations. such as tailors - dressmakers - clerks compositors - shoemakers - milliners &c &c. But - in such an atmosphere there is the presence of excess of Carbonic Acid Gas & other impurities as well as the diminution of Oxygen & therefore it - is difficult - to determine the part - played by Oxygen in the production of disease.

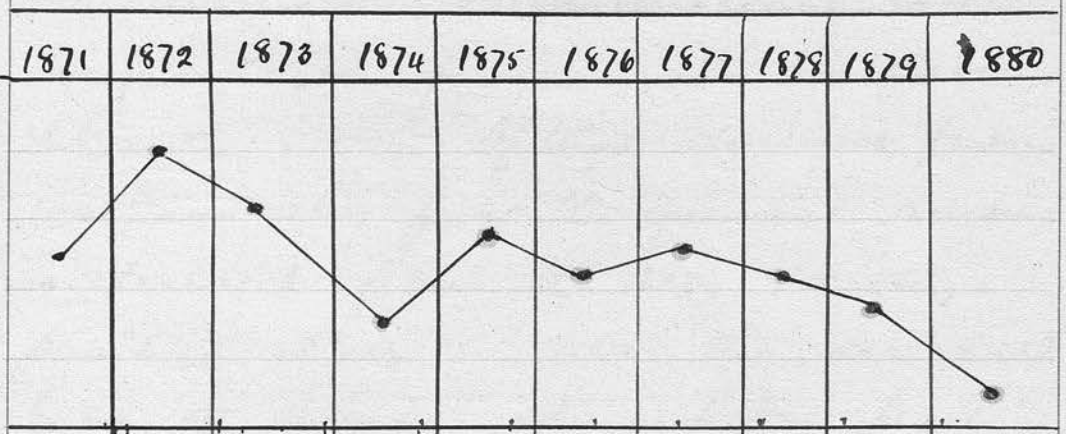
Heat of air has by itself no appreciable influence on Phthisis Mortality - Certainly there is none to be discovered in the English Rate as is shown in Map No 6 where isothermals are shown for January & August. One would naturally expect - a higher rate in the Colder districts as Cold

is liable to bring on those diseases which most frequently precede Phthisis & in the colder districts people are more apt to live in ill ventilated apartments that they may expend as small an amount of heat as possible. However this is contrary to experience for in Iceland & Greenland Phthisis is said to be less common than at home — & again in some of the hottest districts of the World Phthisis is unknown while in others it is very prevalent.

Acute variations in temperature by their "lowering" influence on the body & by predisposing to inflammatory affections of the lungs doubtless will have an influence on the mortality from this disease but unfortunately it is so remote that it is very difficult to estimate for a Phthisis developed now may not prove fatal for many years

The following table shows the

influence of temperature on the Rate of Phthisis mortality - during the ten years 1871 - 1880.



The Registrar General in his 3rd Annual Report says that Statistical investigation shows no influence on Phthisis mortality. This is not the case with other lung affections Bronchitis Rates are doubled by a depression of temperature.

3 Atmospheric humidity of any district is derived from two great sources — extrinsically by the Wind from other districts & intrinsically by evaporation from water surfaces & land. — Of that derived from without by far the greatest amount is derived from the sea & caeteris paribus districts near the sea will have a moist atmosphere from this cause when the Wind blows off the sea. Westerly winds will contain more moisture than those from the East as the westerly ones come over a great expanse of ocean. while the easterly winds come over a great expanse of land. Moisture is soon abstracted from the atmosphere by passing over land & especially high land as is seen in Map. No 8 Rainfall is a pretty accurate indication of the atmospheric humidity which is derived from this source As to the amount of importance

to be attached to this form there is considerable difference of opinion.
Benicke Prof: Benke of Marburg attributes the (40)
beneficial effects of sea air to its moisture — He hung out a flask of water at 60C. with thermometer attached & noted the time taken to cool this down five degrees — He also observed the influence of clothing on the flask — He found that the loss of heat was far more rapid in sea air than mountain air — This was due to the presence of more moisture in sea air than in hill air. the temperature in both being equal. The greater loss of heat requires increased tissue metabolism & hence the bracing effect of the sea air & its beneficial effect on the general health.
Many sea coast towns have a low Phthisis rate but this is by no means a uniform rule for soil & individual hygiene have a more powerful influence & prevent us from drawing deductions from

the English rates as regards humidity:
However it is a well authenticated
fact that certain of our Western Islands
& islands in other parts of the Globe
exposed constantly to a moist
atmosphere, enjoy & have enjoyed
a perfect or nearly perfect immunity
from the disease -
Both Dr Green & Mr Hill write from
the New Hebrides group of South
Sea islands to say that Phthisis
is markedly increasing, being unknown
twenty-five years ago. They do not
give statistics but state positively
that the increase is well marked.
attributing it to the introduction of
tubercle by slaves from the
Australian Continent. This is
but a confirmation of a statement
made by Dr Budd of Clifton many
years ago — that Phthisis was not
known among the South Sea
Islanders till introduced. — Dr David
Livingstone noted a similar state
of affairs as existing in Africa

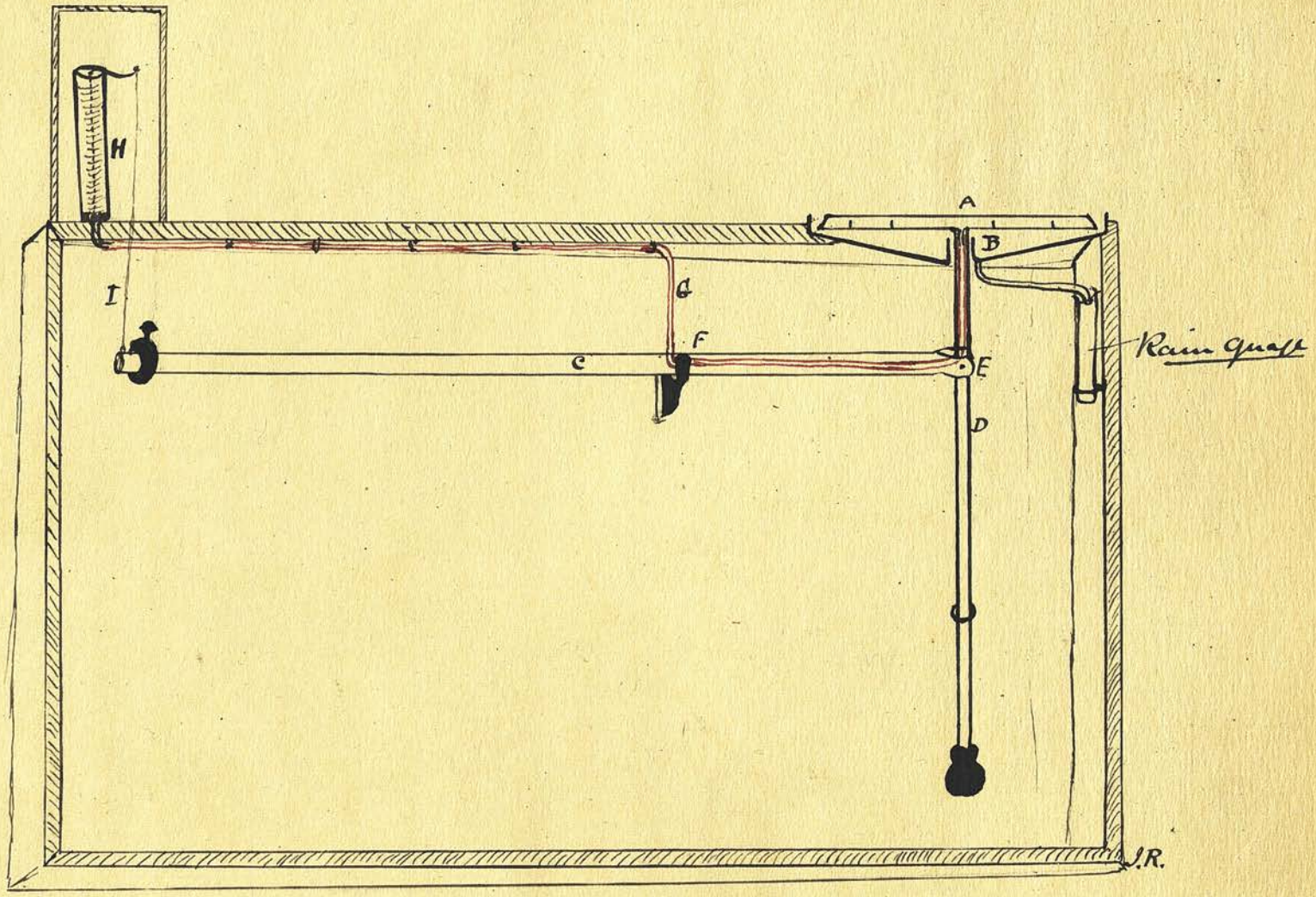
(by private letter)

(64)

where Phthisis is prevalent- whenever the natives have contact with Eurasians while in the interior where no contact is had phthisis is unknown. Much the same condition was observed by Dr Rush of Philadelphia.
I quote these facts here to show that probably hygrometrical Conditions of the atmosphere alone influence but little the Phthisis mortality of a place for the difference between the amount of Aqueous Vapour in the atmosphere in the South Sea islands on the one hand & in the interior of africa on the other is extreme. yet both enjoy immunity — And again there can be but little difference in the Amount of Aqueous Vapour passing over our Western isles & that on the shore of the Mainland yet here the Phthisis rates differ much
Some of the Western isles are free whilst others have excessive Rates. as was shown by Dr Morgan (59) (60)

The second form of atmospheric humidity is for us more important than the first - it is that derived from the soil & from free water surfaces - No method has as yet been devised for measuring this alone accurately - Dr Hampton in his Lectures on Physical Geography says he found the evaporation to exceed the Rainfall at Dublin by nearly an inch. - Collin gives the results of his observations in France & Greaves the results of 14 years observation at London - All these show that rainfall is intimately connected with evaporation - In most cases the rainfall was observed to exceed the evaporation by a small amount (3 - 8 per cent) & consequently the districts of greatest rainfall will have the greatest amount of Evaporation - So that Map No 8 will indicate approximately the amount of evaporation from this cause - it only shows the

distribution approximately for Geological formation of the soil has been shown to have an influence on the ease with which water is given out to the atmosphere But the chief importance to be attached to evaporation lies in the fact that it is our only method of estimating the amount of transference of gases from soil to air - & along with gases, microorganisms which according to Pettenkofer* (80) & Hesse* have been carried down (43) by Rain, multiplied in the soil & given out into the air again by the upward movement of the gases. Mr. Aitken in his recent paper on "A New Theory of Dew Formation" (Edin: Royal: Soc 1887 shows clearly the large amount of transference of gases constantly going on between Air & Soil It therefore becomes a necessity to have an instrument which will register the amount of water gas capable of being taken up.



Sectional Diagram of new Balance Atmometer (in use in garden of N°11 West End Place)

by the air, not at the time of observation but during a period of time — ie twenty four hours — On account of the extremely unsatisfactory results as yet obtained I here give a drawing of an instrument which though by no means perfect gives fairly satisfactory results & has the very great advantage of being self acting & easily works — It is on the principle of the old balance atmometer & registers the amount of water taken from a free water surface of known size during 24 hours or oftener. — The water is kept at a constant level by means of the balance & there is a means of making allowance for rainfall. A is a circular pan 8in in diameter & 1/4in deep into which a thick piece of flannel is placed & then water The flannel prevents splashing during wind by its capillarity & yet a perfect free water surface is exposed. B is a rain collector

& also it collects any water which escapes from A by a simple calculation the amount of Rain & of splashing can be allowed for. C is a hollow beam bearing the pan A at one end & an adjustable weight at the other. The hollow tube D is moveable at E & the small indiarubber supply tube G runs from the pan A through D & the beam C to the Reservoir H. which is opened & shut by the cord attached to the beam. — By adjusting the weight carefully one Cubic Centimeter will turn the balance & open the reservoir. — The whole is enclosed in a wooden box & exposed at the level of the ground in an open space. It is necessary to enclose the pan in a light wire frame to prevent birds &c influencing the results.

The way in which Evaporation influences Phthisis will be more satisfactorily treated later

when the impurities of the atmosphere have been considered — Suffice it here to say that I shall attempt to show that it is one of the best means of estimating the amount of transference of Gases & microbes from soil to air.

Impurities in the Air.

The presence of inorganic particles in the air has long been recognised as a cause of Phthisis — but only lately has their true etiological value been recognised — That many cases of Anthracosis — Stone-masons Lung — Grinders-Rot — &c do not become tubercular is well authenticated but the majority do — It was Dr Leigler who first pointed out the fact that epithelial catarrh always precedes tuberculosis. &

!!

Dr Woodhead has substantiated this statement. — As regards Phthisis distribution this ~~theory~~ fact is of the utmost importance - for, from whatever cause catarrh be induced the greater the amount of it the greater the liability to Tubercular disease. —

Dr Farrs evidence as a specialist before the Royal commission on Mines shows very clearly the large per centage of Phthisis among miners & also that in the better ventilated mines & consequently those where there was least coal dust in the atmosphere, that the percentage of Phthisis cases was less than in ill ventilated ones. — Since the Amendment of the Mines Act the Registrar General has shown has shown a steady decrease in Phthisis among miners. There is another interesting fact shown by Dr Haviland's Maps & also mentioned by Dr Farr (81)

that Phthisis is far more prevalent among the females in mining districts than elsewhere under similar circumstances — This fact is not easy of explanation unless one admit the contagion theory. Every other known trade which necessitates its operatives to work in a dusty atmosphere has an excessive Phthisis mortality, but this ~~this~~ excessive mortality varies with the degree of irritation caused by the dust inhaled eg. Stone & Metal dust appears to be more hurtful than that to which the flour miller or cloth manufacturer is exposed. & this is substantiated by Chart No 4 where the mining districts are shown to have the greatest mortality — then the hardware districts — next hosiery & cloth manufacturing districts & lastly the Agricultural ones.

Organic Impurities. form a far more potent poisons in the atmosphere than the preceding though not so apparent to the general observer. The vitiation of the atmosphere from this cause is probably the ~~cause~~ most frequent cause of Phthisis. though one whose influence on the disease is difficult to demonstrate. I believe the Modus operandi of such is that the deficiency of oxygen & excess of Carbonic acid & other impurities produces a lowered vitality which seems to be a sine qua non of the disease & this when catarrh is present renders the individual susceptible to tuberculosis. Overcrowding has always been identified with high Phthisis Rates — The excess of Phthisis mortality in towns is probably due to this, which in reality means "defective ventilation" This excess of town Phthisis is well

demonstrated in the Registrar General for Scotland's annual reports 1861 - 1885.

The results are also shown by the list of occupations of Phthisical patients at the various hospitals. The majority of these have been employed 'indoors' - & in many cases have worked in ill ventilated rooms - One cannot help being struck by the defective ventilation in many workshops & offices &c. & till a knowledge of the baneful effects of such becomes more wide spread but little can be done to relieve it. The same condition occurs ~~occurs~~ in private houses especially those of the poor where heat versus ventilation is a consideration This naturally leads us to the subject of the communicability of Phthisis, about which there has been so much discussion lately. The vast consensus of opinion in this County, in France

in Germany in Italy & America seems to point to its being contagious under certain conditions —
The subject is so important in this inquiry that I will here quote a series of experiments I made during a Voyage on the "S.S. Lantis" to China & which though incomplete are important —
Acting as Surgeon on board I had to attend a Sailor James Brown A.B. who came on board at Liverpool suffering from advanced tubercular Phthisis & Fistula — There were large cavities in both lungs & his sputum contained Tubercle Bacilli
It occured to me that if watery vapour were added to the expired air probably also tubercle Bacilli would be added as they lie free in the sputum. I therefore got the man to breath through a tube surrounded by ether & in this way was able to collect about 10 C.C. of this condensed watery vapour.

This was allowed to evaporate to a quarter of its bulk — then placed on two cover glasses & evaporated to dryness - stained by Ehrlichs method & mounted — Bacilli were found on both glasses — Since then I examined Brown frequently in the same way & on nearly every occasion found bacilli - To prevent loss during mounting I now add a small quantity of egg albumen to make an artificial Sputum. Since then 17 Cases of advanced Phthisis were examined in this way — each having Bacilli in the Sputum — in eleven of these there were Bacilli in the expired air & in the remaining six none were found though in each of these I examined the condensed Watery Vapour on more than one occasion. The rationale of the process is that while the Water Gas in Expired air is being condensed in the tube, the small particles of water

carry down the Bacilli - as rain does the soot & other particles in the air. The instrument I use at present is a glass tube 14in long & 1/2in bore - this is surrounded by a brass tube 6in long & 1in in diameter - This brass tube is the receptacle for the ether by the evaporation of which sufficient cold is obtained

It is easily worked & portable & the fluid in the test-tube is best evaporated over Chloride of Calcium as prolonged heating renders bacilli less susceptible to staining. Since this voyage while examining

the literature on the subject. I find that Dr. Ransom has described a similar method – only he uses a much larger vessel & a freezing mixture instead of the ether. (18)

It is therefore proved beyond doubt that the micro-organisms which we associate with Tubercular disease of the lung are given out into the atmosphere – This has been shown with no other Zymotic disease. I have examined the air of the rooms occupied by Tubercular patients but have not yet been able to obtain bacilli probably from imperfections of Method.

What then is the ultimate life history of these Germs which enter the air? & do they exert any influence on those who come in contact with them? The first of these we cannot as yet answer as we do not know sufficient of the laws of Growth of the

organisms. But by analogy from other diseases such as Scarlet Fever & Diphtheria & by actual experiment with Bacterium termo we surmise that the special organisms have the power of retaining their vitality for long periods in a latent condition & if at any time they come in contact with suitable soil they will multiply & coincident with this the special signs of tubercular disease manifest themselves. — Whether the Bacilli themselves or a special poison developed by them produces the special disease does not affect our present point. The relative degrees of virulence of the disease from the acute or galloping Consumption to the extremely slow chronic forms has its analogy in other zymotic diseases as also has the relative susceptibility of individuals to the disease. The answer to the second question on p. 65 is more difficult than

the first for it implies an answer to the much contended question "Is Phthisis contagious?" — Much writing & clinical investigation & especially the labours of the Collective investigation Committee of the British Medical Assoc^n go to prove that it is — but I do not know of any experimental investigation on this subject. I therefore quote here the continuation of the experiments made with the man Brown on board of the "S.S. Laertes". 73

Having ascertained definitely the presence of Bacilli in the air he expired I resolved to keep a number of animals in such an atmosphere for a long period & under conditions which I calculated would render them susceptible to the disease. Rats being the only animals available I procured eight — keeping them in square tin boxes with glass covers Both lots were kept under the same conditions for nine days — a small

allowance of food only being given them & ventilation deficient - Three died during this period so that Box A contained 3 which we shall number for convenience of reference as No 1, 2 & 3 Box B contained two No 4 & No 5. The rats having become acclimatized to their new home, on ~~January~~ February 8th bacillus-laden air was admitted to Box A. - Brown respired through the tube & filled the box with his expired air - This was done for five minutes at a time three times a day & sometimes more frequently - In Box B the air was changed twice daily. - On February 16th rat No 2 died during a period of excessive heat & at short intervals No 1 & 4 leaving on the 28th only No 3 a male & No 5 a female alive. The treatment was carried on till the Ship reached Singapore on March 10th a period of 29 days in all. Here unfortunately Brown was discharged on account of his inability to work. But a spare

allowance of food was maintained till March 6th when both remaining rats died of starvation. The treatment caused all to become emaciated & enfeebled & occasionally to prevent death the last two had to be resuscitated by being fed well & under good sanitary conditions. There was no evidence of lung mischief at anytime evident by physical examination. The thoracic organs of each rat was preserved & since then I have examined each microscopically No change was found in the lungs of No. 1. 2. 4. & 5 except the presence of considerable quantities of Anthracosis. In No 3 acute tuberculosis was present — the distribution was general — no place in the lung appearing to be free of the tubercular nodules except the interior Bacilli were easily demonstrated to be present by the Erlich method. Since this voyage I have examined the lungs of many rats & in no

* (I have detailed daily accounts of the above experiments)

instance have I found tubercle & I cannot find any record of tuberculosis ever having been noticed in the Rat family.
Due allowance being therefore made for the element of accident in this case — It must be taken as strong confirmatory evidence of the infectibility of Tubercle *

Granting then for the meantime the "Contagion Theory" that Phthisis is caused directly or indirectly by a specific Microbe — capable of being propagated from one individual to another & developing in the body only under certain conditions there being a lowered vitality of the tissues & an epithelial Catarrh."
let us look at how such will affect the distributions. By a careful study of the distribution the strongest confirmatory evidence of the theory is obtained. Town Phthisis rates are much greater than rural ones — such a chart as No 6.

gives a fallacious idea of the Phthisis rates in relation to density for towns vary so considerably in their distribution. I have therefore calculated the the number of people per cent in each district who live in towns over 5000 inhabitants & it will be seen that the most densely peopled districts have the Greatest Phthisis Mortality Dr Farr has calculated that there is 39 per cent more Phthisis in towns than in the country. I would wish to lay the Greatest possible stress on this for increased density is actually though not necessarily a cause of Phthisis - The exceptions to this will be considered later. Increased percentage of town population of a district involves concentration of people in workshops. shops offices &c & this in turn implies that town populations are exposed more to vitiated atmospheres & enfeebling the constitution &

putting them in a better condition for
these tubercular disease — the germs
of which can be transmitted from
one to another with greater ease
than in the ~~town~~ County on
account of the proximity of one
tubercular case to another. But
density alone does not govern
the distribution for towns vary
greatly in their Phthisis rates as
is well seen in the Lancashire towns — Towns on the West-
Coast of England almost-
without exception have high
phthisis rates — a fact which is
best explained by admitting the
contagious theory & that the microorganisms
which induce the disease are in
a better position to develope
when in the moist West atmosphere.
The same holds good with
rural districts for in them occupation
does not vary so much as in
towns yet Phthisis rates are
markedly higher in the Western

rural district than in the Eastern

Conditions in the soil which influence (12)
Phthisis are as yet but little
known - The classic investigation
of Dr Buchanan is the only one Charts 10 & 11
undertaken as yet in this country.
Unfortunately a complete analysis
of the Relation of Phthisis mortality to soils
throughout the whole of England
is not possible as the Geological
Survey is not complete & materials
are only accessible to Government
officials - But very important
& interesting conclusions are
drawn from the analysis made
by Dr Buchanan of Kent Surrey
& Sussex Counties. - In these
there are a large variety of Geological

formations. I have appended a
Copy of Dr Buchanans Geological map No 11
with the relative distribution marked
on it. Composition will be seen
to influence distribution only in so
far as certain soils retain moisture
more readily than others. Dr Buchanan
says that probably dampness of
soil alone influences Phthisis
distribution — But this is dependant
on many conditions, chiefly on
the ease with which water is
taken out of the soil either by the
natural means of inclination or
by porosity or by the artificial
means of drainage deep or ~~surface~~ surface
or by opening the outflow. It is
evident therefore that much could
be done to remedy this as a cause
of Phthisis & the evidence (see Chap. 10)
which has already been obtained
of the influence of deep drainage
on Phthisis mortality is most
satisfactory.

On examining Sir R. Murchisons

Geological Map of England one cannot help being struck with the fact that there is a larger quantity of Clay & alluvial soils in the Eastern & midland districts than in the Western districts & also that there is in the western Districts greater elevation & therefore for both reasons water will more readily get away. This is at first sight contradictory to Dr. Buchanans Theory – but probably the explanation is that dampness of soil acts as a cause of Phthisis in more ways than one. – It produces Catarrhs & other lung affections which precede Phthisis. but also it causes a moist condition of the atmosphere which seems to be favourable to growth & development of Microbes. This latter modus operandi is further borne out by the distribution of atmospheric

humidity — Maps Nos 101 - 102. 98. 89
79. 78. 74. 60 57 40 41 38
37 36 42 21 25 & 30
~~show~~ of the Geological Survey
show an unusual amount of
permeable soils with much
inclination while these are the
districts of greatest Phthisis
Mortality — On the other hand
Maps. Nos 82 83 71 68 66
64 52. 51 50 & 47
of the Geological Survey show
impermeable soils & a much
less degree of inclination while
on these districts Phthisis mortality
is very low.
On the one hand however
there is a large amount of
Atmospheric humidity - while on
the other there is little.

The influence of heredity - about which there has been so much discussion lately is undoubtedly if not a cause - a predisposition to the disease - It only affects us at present in so far that in districts where Phthisis is most frequent there the influence of heredity will probably be most intense.

Race has been said to predispose to Phthisis but the evidence is so conflicting that nothing satisfactory can be argued from it - In England the Celts & Saxons have been so mixed by intermarriage for many years that few instances of pure strain there can be found.

I cannot find any marked cause either in the individual hygiene

of the community or their habits of life which will influence distribution. This is a subject of extreme complexity for in different ~~different~~ districts the modes of living & hygeine differ greatly yet in all there are apparent errors which alone can be removed by education & sanitary reform. —

We therefore see that the three principle elements governing the distribution of Phthisis are
I Moisture of Atmosphere
II Density of Population
III Occupation of a Community
Where the three conditions are combined there we have there ~~we have~~ the greatest Phthisis mortality. We have therefore

our Maximum of Phthisis mortality in our half Manufacturing towns in the Western districts & most in the Coal & Cotton towns in other districts in England. The Welsh rates are fallacious, they have not diminished at the same rate as those in other parts of the Country while the Bronchitis rates in Wales have remained stationary while in other districts they have increased as the Phthisis ones decreased. This is probably due to more conservative views being held by the Welsh practitioners as to the nature of the diseases. Although we make an allowance for this at the rate of decrease as in other Counties still the Welsh rates are as high as other Counties exposed to the Western "moisture"

The conclusion one would draw from the foregoing pages

therefore is — I That at present the Registrar General includes many distinct diseases under the heading of Phthisis — the etiology of which are very different — But by far the largest percentage are cases of Tuberculosis of the Lungs

II That Tuberculosis is a Contagious disease — the distribution of which is favoured by certain conditions of atmosphere & General health of the individual (By this I mean both the General lowering of vitality & the special local lesion in the Lung — the two appearing to be essential to the development of Tuberculosis.

III That the causes which predispose to Phthisis are to a great extent under controll & that in tubercular cases this controll only extends to its prevention. Therefore we may expect a still greater diminution in Phthisis death Rates, than has taken place in the past — The Registrar

General says that after making allowance for the increase in other pulmonary diseases Phthisis Rates are seen to remain stationary for many years past But this is a real improvement as density of population has increased since 1871 as 2 to 3. & thus means increased town population & indoor occupations &c. &

This is but one indication of what a better education of the people in General & Individual hygiene will accomplish in the prevention of a disease which is so well described in the following lines.

Matres atque viri defunctaque corpora vitae
Magnanimum heroum pueri innuptaque puellae
Impositique rogis juvenes ante ora parentum.

John Robertson.
April 26th 1887.

The following are the Works & papers which were consulted in the production of the foregoing —

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2 Influence of Climate on Consumption Dr Williams
3 Pulmonary Consumption Dr C.B. Williams
4 Climatic Treatment of Consumption Dr Thorowgood
5 Gulstonian Lectures on Natural History of Consumption.
6 Practical Treatise on tuberculosis.
7 Consumption its nature & Cure Dr H. Green
8 Nature & Cause of Consumption Dr Govans
9 Consumption & Tuberculosis Dr Dobell
10 Scrofula & Phthisis By M. Bariéty
11 Acute Phthisis & tubercular peritonitis Dr Anderson
12 Reports of Med: Officer to Privy Council. (especially those for 1866 & 69)
13 Consumption as a Contagious disease Dr Cullimore
14 Loss of Weight & Blood Spitting Dr Dobell
15 Distribution of Heart disease &c. Haviland.
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17 Diseases of the Lung Dr Walshe

18 Proceedings of the Royal Society - 1882 Dr Ransome
19 Reports of Registrar Gen: for England till 1883.
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21 Etudes sur la tuberculose Dr. Villemin.
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27 Six Lectures on Physical Geography. Rev: Hampton.
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49 Do Do Do 1884 Nov 8th Dr Ransome
60 " " " " Do Dr McKenzie
61 " " " 1884 December 6th Dr Vallin
62 " " " 1883 Vol I p507 Dr W. Cheyne
53 " " " 1882 Vol I Dr Edwards
54 " " " 1874 Vol I Dr H. Weber
55 " " " 1885 Vol I Dr Creighton
56 Edin: Medical Journal. 1867 M. Villemin
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63 Waldenburg die Tuberculose die Lungenschwindsucht. p 524.
64 Lancet Oct 1867 Dr Budd
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66 Do Do Dr Weber.

67 Parliamentary Returns (Nº 12 1868.) (Nº 130 1875)
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69 Munchisons Geological maps of England
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72 Berliner klinische Wochenschrift - Ap. 10th 1882.
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75 Lancet Vol II 1880 p 871
76 Brit. Med Journal 1880 Vol I Colnheim
77 Influence of Tropical Climates Dr. Martin
78 Reynolds System of Medicine - "Phthisis"
79 Edin Med: Journal. 1886. Dr James
80 Manual of Hygiene Pettenkofer & Leissen
81 Rep: of Royal Commission on Mines.

Death-Rates per 1000 from Phthisis (1871–80)

No 1

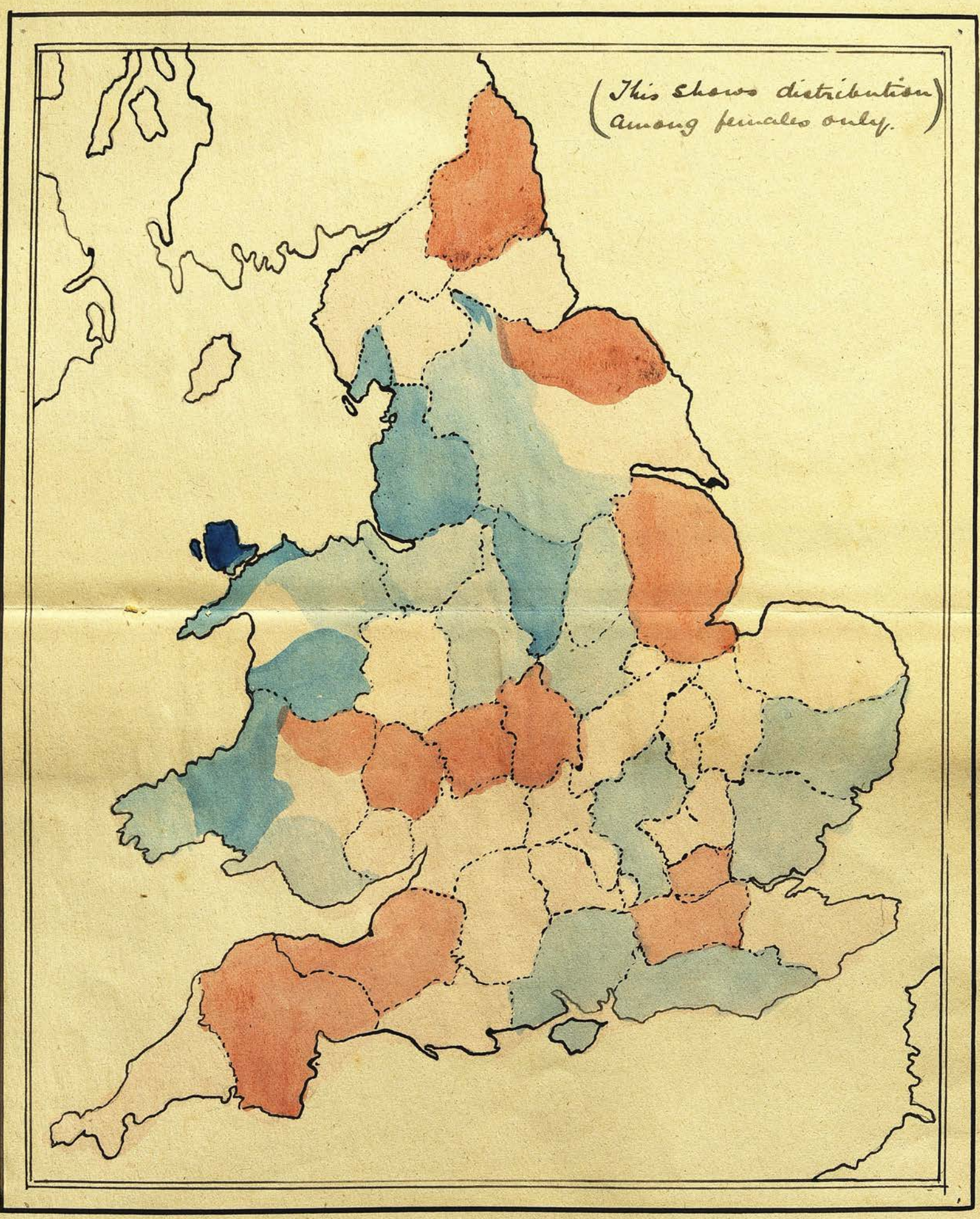
	1871	1872	1873	1874	1875	1876	1877	1878	1879	1880	Average.
1	2	3	4	5	6	7	8	9	10	11	12
1 North Wales	2·82	2·57	2·80	2·34	2·75	2·68	2·62	2·46	2·46	2·35	2·58
2 South Wales	2·71	2·57	2·74	2·42	2·60	2·41	2·48	2·64	2·47	2·28	2·53
3 Lancashire	2·88	2·78	2·60	2·47	2·61	2·46	2·41	2·40	2·26	2·10	2·49
4 Yorkshire (West)	2·53	2·47	2·36	2·15	2·35	2·34	2·21	2·24	2·17	1·95	2·27
5 Northumberland	2·49	2·24	2·36	2·32	2·24	2·31	2·38	2·12	2·14	2·08	2·26
6 Cumberland	2·56	2·53	2·53	2·24	2·03	2·14	2·16	1·87	2·17	1·88	2·21
7 Hampshire	2·37	2·23	2·21	2·08	2·34	2·14	2·24	2·29	2·13	2·07	2·21
8 Cornwall	2·39	2·35	2·20	2·19	2·08	2·31	2·22	1·99	2·04	2·03	2·18
9 Bedford	2·44	2·14	2·07	2·16	2·16	1·98	2·26	2·02	1·85	1·79	2·08
10 Sussex	2·56	2·14	2·11	2·14	2·03	2·23	1·88	2·00	2·13	1·96	2·11
11 Devon	2·23	2·23	1·98	2·00	2·10	1·93	1·99	2·16	2·13	1·80	2·05
12 Westmorland	2·51	2·24	2·00	1·86	1·89	1·77	1·90	1·85	2·20	2·17	2·03
13 Suffolk	2·27	2·16	2·04	1·85	2·11	1·94	2·08	2·04	1·99	1·91	2·03
14 Cheshire	2·22	2·33	2·11	1·98	2·04	1·96	1·89	1·96	1·97	1·76	2·02
15 Nottingham	2·27	2·13	2·06	2·34	2·08	2·06	1·77	1·86	1·89	1·73	2·01
16 Yorkshire (East)	2·04	2·16	1·96	2·07	2·12	1·87	1·80	2·08	1·93	1·64	1·97
17 Cambridge	2·23	2·19	1·93	1·76	2·21	1·97	1·94	1·85	1·89	1·82	1·97
18 Warwick	2·15	2·11	2·08	2·00	2·00	1·87	1·92	1·98	1·80	1·72	1·96
19 Durham	1·98	2·19	2·01	1·98	1·90	1·90	1·98	1·84	1·83	1·81	1·94
20 Berkshire	2·18	1·99	2·04	1·98	2·08	1·86	1·89	1·79	1·88	1·63	1·93
21 Surrey	2·07	2·14	2·06	1·82	1·96	1·98	1·86	1·96	1·79	1·61	1·92
22 Derby	2·14	2·14	2·01	1·84	1·76	1·87	1·86	1·98	1·91	1·69	1·92
23 Norfolk	2·05	2·16	2·00	1·78	2·04	1·93	1·86	1·96	1·83	1·68	1·92
24 Huntingdon	2·11	2·22	2·01	1·85	2·10	1·99	2·04	1·53	1·68	1·64	1·91
25 Essex	2·34	2·01	1·96	1·78	1·89	1·83	1·82	1·78	1·72	1·64	1·87
26 Oxford	2·05	1·98	2·01	1·90	1·72	201	1·64	1·82	1·74	1·73	1·86
27 Northampton	2·23	2·11	1·88	1·73	1·98	1·79	1·77	1·86	1·81	1·50	1·86
28 Kent	2·00	1·94	1·89	1·75	1·91	1·80	1·75	1·88	1·76	1·68	1·83
29 Middlesex	2·10	2·04	1·99	1·84	1·89	1·89	1·70	1·76	1·59	1·47	1·82
30 Gloucester	2·10	1·89	1·86	1·73	2·02	1·76	170	1·83	1·75	1·55	1·81
31 Monmouth	2·01	1·92	1·86	1·91	1·73	1·72	1·71	1·81	1·81	1·45	1·79
32 Leicester	1·94	2·05	1·89	1·75	1·73	1·72	1·73	1·86	1·66	1·53	1·78
33 Hertford	1·99	1·83	1·76	1·88	2·03	1·81	1·55	1·87	1·48	1·56	1·77
34 Wiltshire	1·92	1·97	1·70	1·72	1·82	1·58	1·79	1·65	1·62	1·56	1·73
35 ~~Dorset~~ York (North)	2·04	1·62	1·62	1·53	1·81	1·85	1·85	1·64	1·61	1·65	1·72
36 Dorset	1·83	1·74	1·73	1·55	1·91	1·49	1·83	1·68	1·76	1·62	1·71
37 Lincoln	1·92	1·80	1·80	1·73	1·69	1·72	1·62	1·56	1·52	1·56	1·69
38 Buckingham	1·79	1·89	1·70	1·58	1·78	1·64	1·82	1·49	1·63	1·52	1·68
39 Somerset	1·76	1·82	1·60	1·63	1·75	1·56	1·69	1·64	1·54	1·47	1·64
40 Shropshire	1·90	1·76	1·66	1·67	1·60	1·64	1·60	1·73	1·48	1·40	1·63
41 Stafford	1·79	1·72	1·74	1·57	1·57	1·63	1·57	1·58	1·45	1·48	1·61
42 Hereford	1·61	1·47	1·59	1·49	1·67	1·48	1·46	1·32	1·60	1·43	1·51
43 Worcester	1·71	1·56	1·54	1·48	1·58	1·43	1·46	1·45	1·35	1·34	1·49
44 Rutland	1·79	1·45	1·32	0·86	1·11	1·25	1·29	2·07	1·57	1·43	1·40
London: Middlesex	2·74	2·65	2·61	2·57	2·65	2·67	2·55	2·66	2·56	2·34	2·60
London: Surrey	2·56	2·52	2·53	2·36	2·36	2·61	2·49	2·36	2·45	2·33	2·42
London: Kent	2·25	2·25	2·33	2·10	2·10	2·32	2·29	2·05	2·30	2·11	2·19
London											2·40
Mean for each Year	1·97	2·10	2·01	1·86	1·99	1·92	1·94	1·93	1·87	1·75	1·93

nº 2


Geographical Distribution
of Phthisis
The degrees of colouring
represent - degrees of mortality
from Phthisis compiled
from the tables

No 3

Dr Havilands Map of Distribution of Phthisis in 1851 - 60
Copied from page 99 of his work on Geographical distribution of Phthisis



Greatest degree of immunity from Phthisis
Next " " " " " "
Highest Phthisis mortality
Next " "

No 4

General Death Rate

17 18 19 20 21 22 23 24 25

Phthisis Rate per 1000 living

2.5 2.4 2.3 2.2 2.1 2.0 1.9 1.8 1.7 1.6 1.5 1.4

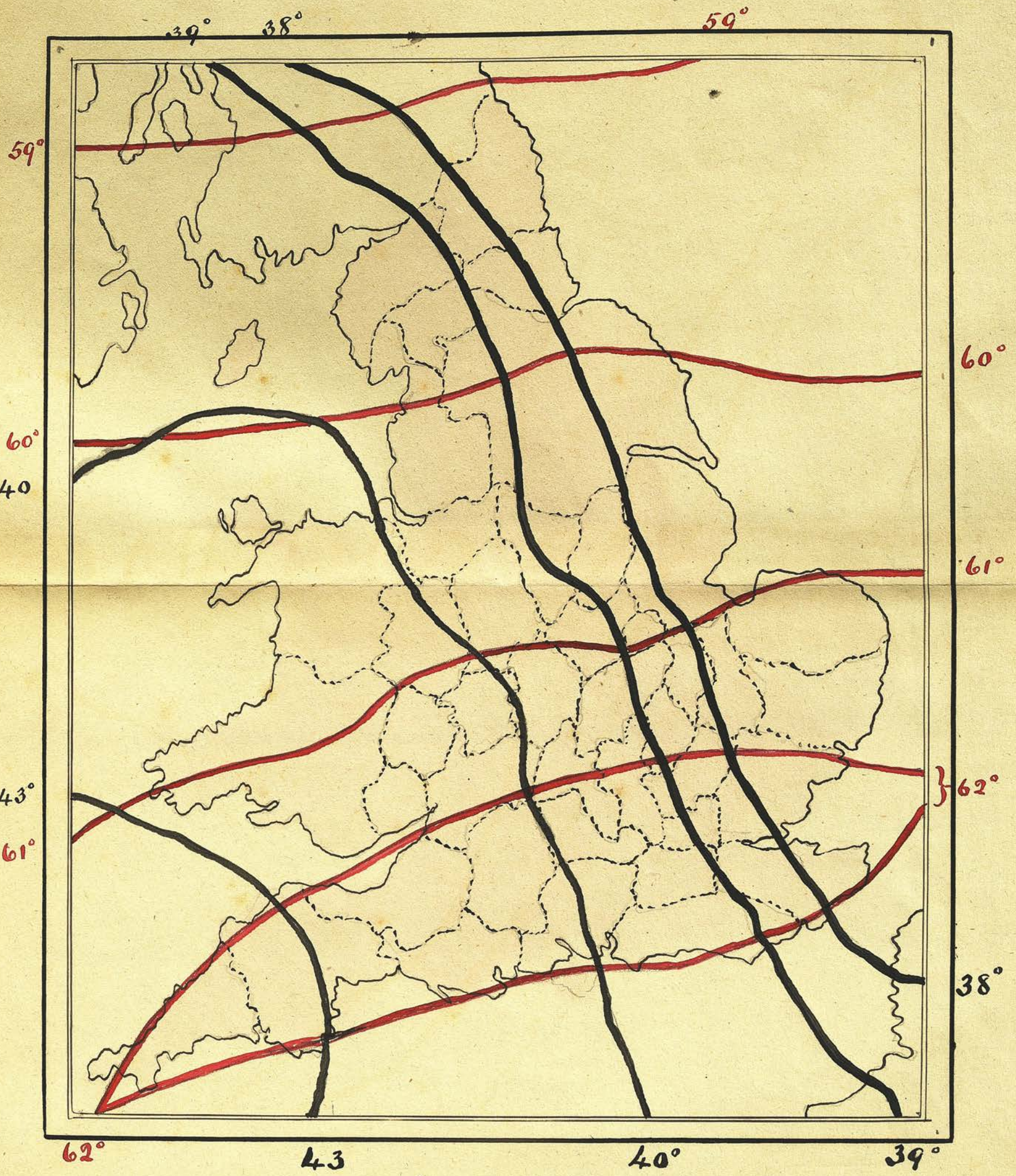
Occupations	Mean Rates for 10 years 1871-80	
Slate – Pottery – Coal –		North Wales
Copper – Tin –		South Wales
Iron Coal. copper		Lancashire
Pottery		Yorkshire W.
Iron works coal – Cotton		Northumberland
Silk. & other manufactures		Cumberland
Cotton – Iron – wool –		Hampshire
Earthenware – Machinery		Cornwall
Coal & Iron. Wool		Bedford
Agriculture – some Iron & Coal		Sussesc
Silk – Hosiery Agriculture		Devon
Copper & Tin – Agriculture		Westmorland
Lace & Straw plait		Suffolk
Agriculture		Cheshire
Lace Agriculture		Nottingham
Agriculture		Yorkshire E.
Agriculture		Cambridge
Manufactures (various)		Warwick
Lace. Silk: &c.		Durham
Iron. Coal – Cotton		Berkshire
Agriculture		Surrey
Hardware – Machinery &c –		Derby
Iron Coal. Cotton Glass other Manufactures.		Norfolk
Agriculture.		Huntingdon
Agriculture. Lace pricelam Coal & Iron		Essesc
Agriculture		Oxford
Agriculture		Northampton
Agriculture		Kent
Coal – Iron – Wool –		Middlesesc
Agriculture – (hops) –		Gloucester
Cloth – wool –		Monmouth
Paper – Coal : Iron		Leicester
Hosiery Agriculture		Hertford
Straw plait Agriculture		Wiltshire
Agriculture		York N.
Coal – Iron. ?		Dorset
Agriculture		Lincoln
Bricks Agriculture		Buckingham
Lace – Silk – Agriculture		Somerset
Agriculture		Shropshire
Iron – coal – Agriculture		Stafford
Iron – Pottery – other manufactures		Hereford
Agriculture		Worcester
China. &c Agriculture		Rutland
Agriculture		London Middlesesc
		" Surrey
		" Kent.

GENERAL-RATE

PHTHISIS-RATE

Distribution of temperature in England
(during January & August-)

No 5

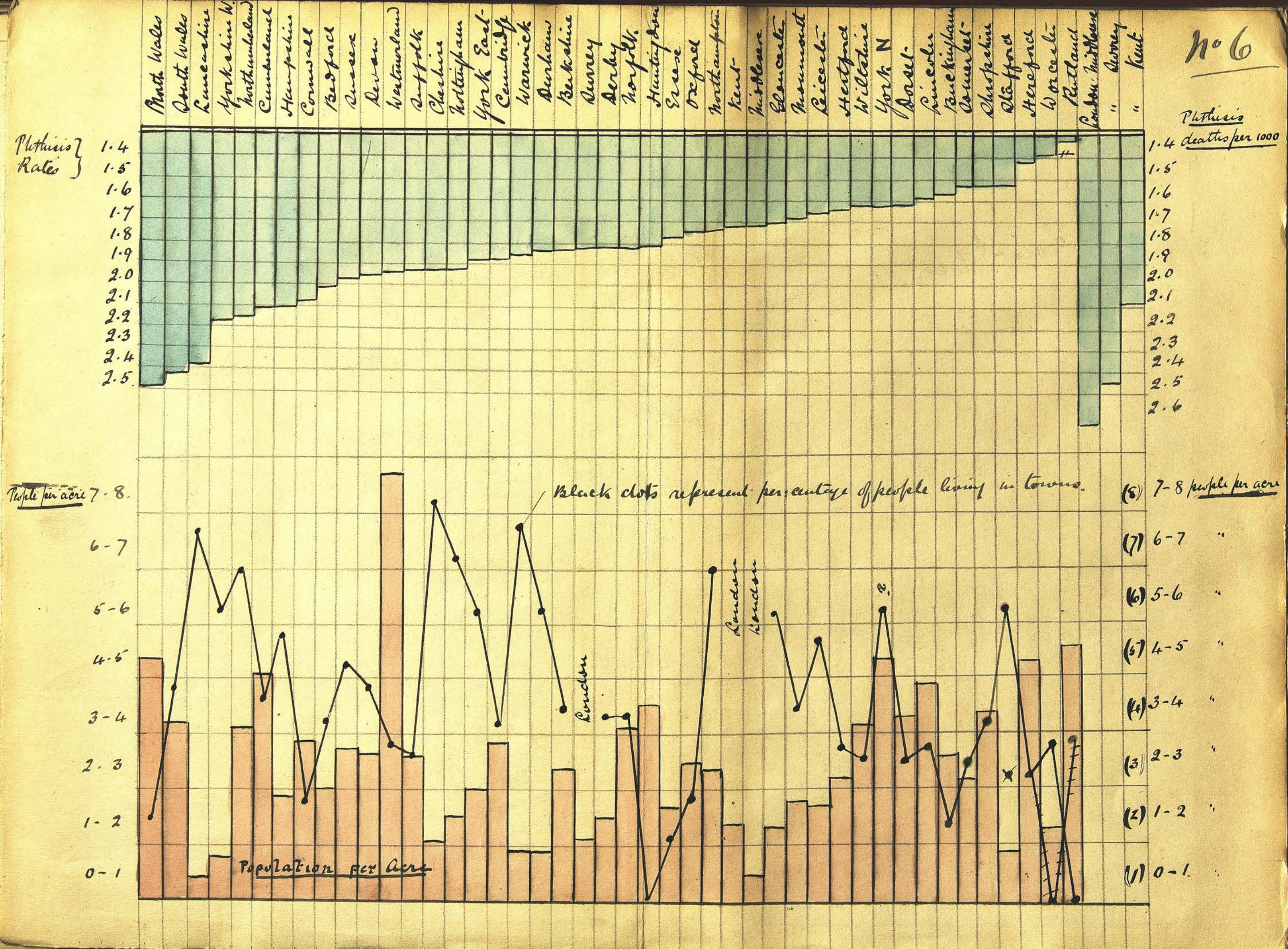


— Isothermals for January (mean for six years 1873 - 78)

— Isothermals for August- (mean for six years 1873 - 78)

(Compiled from The Times Register of Events 1873-78)

No 6


Phthisis Rates
1.4
1.5
1.6
1.7
1.8
1.9
2.0
2.1
2.2
2.3
2.4
2.5
North Wales
South Wales
Lancashire
Yorkshire W.
Northumberland
Cumberland
Hampshire
Cornwall
Bedford
Sussex
Devon
Westmorland
Suffolk
Cheshire
Nottingham
York East
Cambridge
Warwick
Durham
Berkshire
Surrey
Derby
Norfolk
Huntingdon
Essex
Oxford
Northampton
Kent
Wiltshire
Gloucester
Monmouth
Ricards
Hertford
Wiltshire
York N
Dorset
Lincoln
Buckingham
Cumberland
Shropshire
Glasford
Hereford
Worcester
Rutland
London
"
"
Phthisis deaths per 1000
Black dots represent percentage of people living in towns.
Population per Acre
7-8 people per acre
6-7
5-6
4-5
3-4
2-3
1-2
0-1
London
London
London

Distribution of General & Phthisis Rates per 1000 of living population. No 4.

D = General Death Rate
Ph = Phthisis Death Rate

Rainfall Map

No 8.

{ ▬▬ : Lines dividing areas of catchment
The dark colours the largest rainfalls. }

● Excceptionally large Rainfalls

Red numbers indicate Phthisis mortality per 1000 living

(Compiled from Symons Rainfall tables
Report No 47. of Meteorological Council
1883

Rainfall Chart

Compiled from Symons British Rainfall No 9

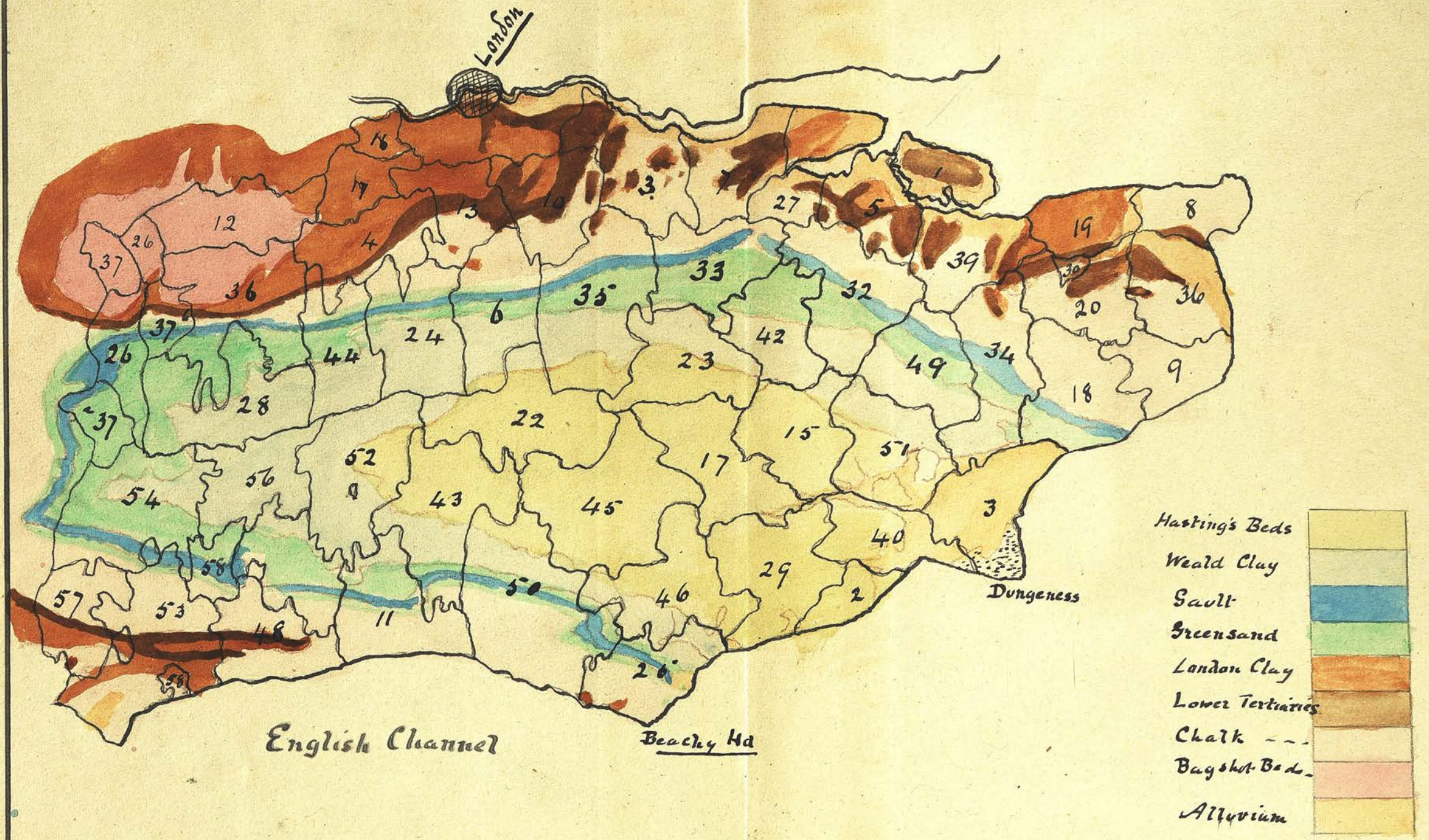
I	II	III	IV	
County	No of Stations in County	Mean Rainfall per Annum (1866 – 1880) at each Station.	Mean Rainfall for county	
Bedfordshire	1	25·00	25·00	41
Berkshire	5	28·29, 26·94 29·19 26·73 26·03	27·43	31
Buckingham	1	26·71	26·71	36
Cambridge	6	23·60 22·81 23·54 2263 23·34 26·71	23·77	44
Cardigan	1	46·00	46·00	7
Carmarthen	1	51·54	51·54	4
Carnarvon	4	40·79 33·43 51·26 36·94	40·60	11
Channel Isles	3	40·60 39·37 34·72	38.23	15
Cheshire	15	30·45 – 46·81 – 41·55 – 47·58 – 44·77 – 52·51 36·91 – 34·24 – 33·76 – 35·45 – 38·02 – 34·34 – 36·56 – 40·99 – 38·19	3940	13
Cornwall	7	52·75 – 63·68 – 53·27 – 37·64 – 46·06 – 49·90 – 53·87	50·88 (48·52)	5
Cumberland	9	139·29 52·21 51·08 – 37·44 – 30·07 – 46·00 – 53·06 – 54·83 – 60·53	58·61½	6
Derby	10	37·56 52·19 30·62 – 57·14 – 43·36 3666 30·21 47·19 46·89 27·05	40·88	10
Devon	11	47·48 54·18 44·35 38·98 41·95 46·08 34·21 68·96 36·61 34·74 37·15	44·06	9
Dorset	3	35·39 – 36·49 – 33·42	34·76	17
Durham	3	26·66 – 28·05 – 26·42	27·04	35
Essex	4	24·88 – 26·89 – 26·02 – 21·85	24·66	43
Glamorgan	4	44·82 – 43·76 – 51·63 – 37·17	44·34	8
Gloucester	4	36·35 – 28·36 29·77 31·42	31·47	24
Hampshire	7	35·58 29·90 31·20 30·86 35·48 33·08 26·78	31·88	22
Hereford	2	35·99 31·57	33·78	19
Hertford	7	31·61 29·67 25·69 24·22 29·60 30·85 26·66	27·94	29
Huntington	1	24·86	24·86	42
Kent	11	24·06 29·84 29·70 29·87 29·01 30·69 32·81 25·86 26·13 36·81 26·44	29·19	26
Lancashire	29	43·99 – 39·34 – 42·45 – 41·98 – 40·83 – 46·17 – 45·37 – 39·28 45·45 47·70 – 42·22 – 45·14 44·77 34·17 45·66 34·50 40·68 43·81 42·11 43·13 42·26 36·28 38·78 76·77 36·18 42·05 – 45·63 49·53 39·77	44·00	12
Leicester	2	26·83 27·65	27.24	34
Lincoln	12	25·87 23·66 26·03 28·19 26·40 24·81 23·58 23·96 24·83 23·83 30·40 24·95	25·54	40
Merioneth	1	66·89	66·89	1
Monmouth	1	39·29	39·29	14
Middlesex	6	25·82 30·03 24·94 26·97 27·29 26·74	26·96	2 36
Norfolk	8	24·64 26·09 23·45 27·65 27·20 26·87 29·20 28·32	29·17	27
Northampton	4	26·90 27·01 23·78 25·76	28·36	28
Northumberland	16	27·36 – 28·94 30·27 – 26·46 – 27·04 27·60 29·23 29·77 26·25 31·90 32·30 29·69 31·76 33·07 30·33 31·58	27·72	33
Nottingham	3	23·77 – 28·68 – 25·61	26·02	38
Oxfordshire	3	28·55 26·40 26·99	27·31	32
Pembroke	1	34·26	34·26	18
Shropshire	4	36·21 – 39·07 – 29·67 – 26·60	32·88	20
Somerset	8	40·71 33·53 38·18 42·20 32·67 29·96 30·58 29·75	37·19	16
Stafford	5	27·98 – 34·43 – 32·72 – 29·86 – 29·01	30·85	× 25
Suffolk	7	25·77 – 26·44 – 26·21 – 25·39 – 25·98 – 24·22 – 26·06	25·72	39
Surrey	5	28·41 – 24·67 – 26·52 – 26·55 – 25·12 – ~~34·29~~	26·05	37
Sussex	11	33·53 29·65 36·19 31·02 34·29 – 34·17 – 34·90 – 29·16 – 33·95 – 32·19 – 30·69	33·34	20
Warwick	2	33·09 – 27·41	30·25	× 25
Westmoreland	7	82·07 – 47·62 – 48·00 – 49·44 – 49·15 – 40·09 – 68·36	54·96 (2)	2
Wiltshire	4	31·77 – 34·32 – 30·77 – 32·21	32·26	21
Worcester	3	27·58 – 33·13 – 32·42	31·04	25
Yorkshire W.R	18	62·46 42·83 – 27·33 – 63·45 55·75 27·70 25·87 20·72 53·18 26·76 27·97 36·26 33·03 43·26 35·02 41·14	52·36	3
E.R.	1	31·76	31·76	23
N.R	3	28·00 28·68 26·92	27·86	30

Compiled from Dr Buchanans Report on Works &c. Promoting Public Health as examined by him in the years 1865 1866. (9th Rep: Med: Off: of Privy Council)

No. 10

Towns examined	General Death rate per 1000 before works	General Death rate per 1000 after works	Percentage of increase or decrease of Consumption	Nature of Works
Salisbury	27.5	21.9	-49 p.c.	much drying of soil by drainage scheme 1853
Ely	23.9	20.5	-47 p.c	much .. .. .. new sewers 1854
Rugby	19.1	18.6	-43 p.c	some .. .. .. new drainage 1851
Banbury	23.4	20.5	-41 p.c	much .. .. .. subsoil water lowered 8-20ft.
Worthing	15.5	15.3	-36 p.c	some .. .. .. much subsoil water removed
Macclesfield	29.8	23.7	-31 p.c	much .. .. .. new sewers 1853-6
Leicester	26.4	25.2	-32 p.c.	drying of soil by surface & suburban drainage
Newport-	31.8	21.6	-32 p.c	Local drying subsoil water lowered 6-15 ft.
Cheltenham	19.4	18.5	-26 p.c	some drying by sewage system of subsoil water.
Bristol	24.5	24.2	-22 p.c	some drying by sewage system 1854-61
Dover	22.5	20.9	-20 p.c	Local drying drainage 1856.
Warwick	22.7	21.0	-19 p.c	much drying sewage 1856
Croydon	23.7	19.0	-17 p.c.	much drying - subsoil water lowered 7 feet.
Cardiff	33.2	22.6	-17 p.c.	some recent-drying - subsoil water lowered 6-11 ft
Merthyr	33.2	26.2	-11 p.c.	some local drying by sewage scheme 1854
Stratford	21.7	20.2	-1 p.c.	no change of soil. New sewers 1854
Penzance	22.1	22.2	-5 p.c.	no notable change of soil
Brynmawr	27.3	23.2	+6 p.c.	no change of soil. Drainage 1853
Morpeth	26.2	24.7	-8 p.c.	Slight- drying. Sewers 1853
Chelmsford	19.6	21.5	0	no change of soil. still water lodged.
Penrith	25.3	25.0	-5 p.c.	Slight- drying soil. Sewers 1856
Ashby	21.6	20.2	+19 p.c.	some drying subsoil water lowered
Carlisle	28.4	26.1	+10 p.c.	drying with local defects - Drained 1856.
Alnwick	26.2	24.7	+20 p.c	no drying New surface drainage

No 11.



Geological Map of Kent Surrey & Sussex. Showing Registration Districts numbered in order as Phthisis prevails ■ The coloured areas represent the geological formations.

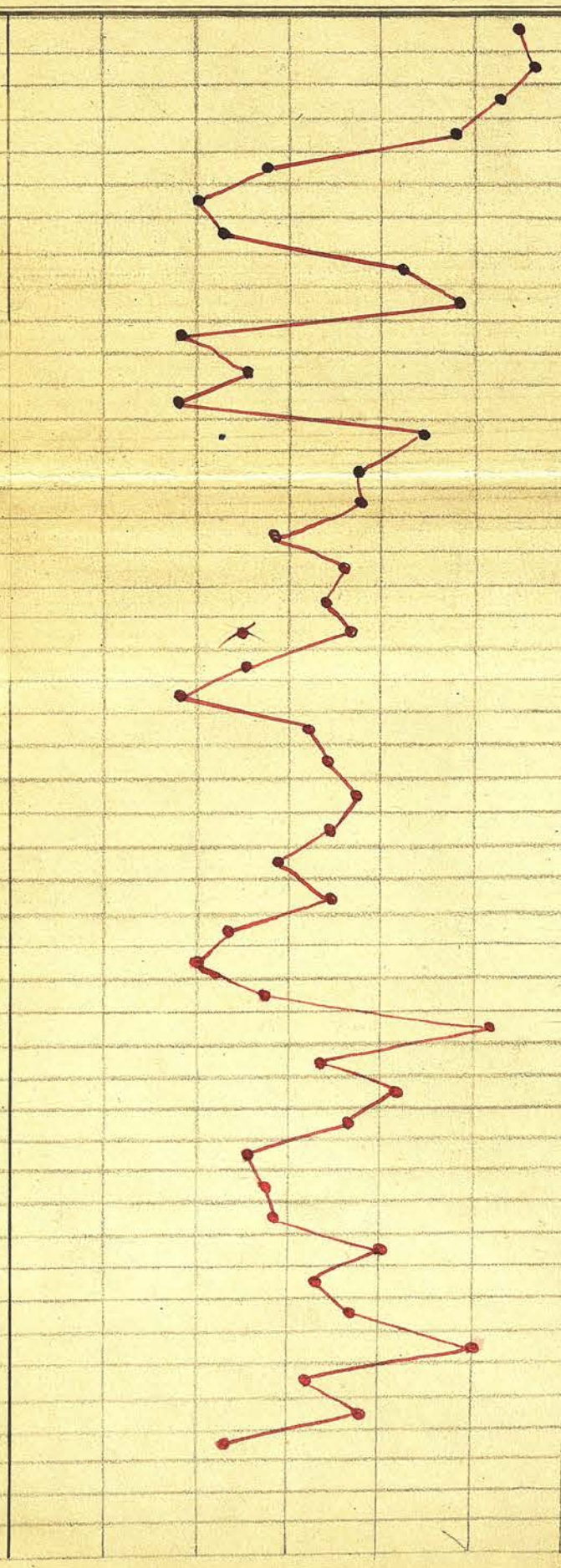
(adapted from Dr Buchanan's Paper.) 10th Rep: Med: Off: Priv: Coun:

No 12

Compiled from Reg: General's Repts to 1871-80
to show existing state of popular education
as indicated by Marriage Register

Relative Proportion of People married who signed Registers by Marks

1 2 3 4 5 6 7 8



Phthisis Rate per Thousand

2.6 2.5 2.4 2.3 2.2 2.1 2.0 1.9 1.8 1.7 1.6 1.5 1.4

North Wales
South Wales
Lancashire
York West-
Northumberland
Cumberland
Hampshire
Cornwall
Bedford
Sussex
Devon
Westmorland
Suffolk
Cheshire
Nottingham
York East-
Cambridge
Warwick
Durham
Berkshire
Surrey
Derby
Norfolk
Huntingdon
Essex
Oxford
Northampton
Kent-
Middlesex
Gloucester
Monmouth
Leicester
Hertford
Wiltshire
York N
Dorset-
Lincoln
Buckingham
Somerset-
Shropshire
Stafford
Hereford
Worcester
Rutland
London { Middlesex
" { Surrey
" { Kent-

1.4 1.5 1.6 1.7 1.8 1.9 2.0 2.1 2.2 2.3 2.4 2.5 2.6

Orf. Greenpeace
" T. R. Fraser
" Turner
" Grainger Stewart